

# **Preliminary Analysis of the Effects of the New Lake Okeechobee Regulation Schedule (LORS2008) on the Performance of the Northern Everglades Lake Okeechobee Technical Plan (LOTP)**

**SFWMD Governing Board Workshop  
June 11, 2008**

***Cal Neidrauer, P.E.,  
Chief Engineer  
Operations Control Department  
South Florida Water Management District***

# Why do this analysis?

- Questions asked by Lake O Committee
  - “Why does the Northern Everglades LOTP & River Watershed Protection Plan (RWPP) modeling assume the old Lake O Regulation Schedule, LORS-2000 (a.k.a. WSE)?”
    - Stakeholder concerns about effects on water supply and discharges to the estuaries

## Response to Question

- LOTP modeling was completed & report sent to legislature Feb '08, before the April '08 approval of the new regulation schedule (aka LORS-2008)
- RWPP modeling ongoing
  - Desire to be consistent with LOTP assumptions
  - Large effort to build capability within RSM to simulate new LORS
  - Schedule for plan development does not include sufficient time to revise model and still meet the January 1, 2009 legislative deadline

## Response to Question (continued)

- Small chance that regional storage areas proposed by LOTP & RWPP's would be constructed & operational within expected life of LORS-2008
- System wide evaluation of new Lake O regulation schedule with CERP Band 1 projects is required by WRDA 2000 Programmatic Regulations
  - System Operating Manual (SOM) Study
- However, sensitivity analysis was still conducted to look at the relative performance of the LOTP with WSE versus the LOTP with LORS-2008

# Results of Sensitivity Analysis

- Results presented to WRAC Lake O Committee in April '08
- Findings showed LOTP w/LORS worsens water supply performance and reduces utility of C43 & C44 reservoirs as compared to LOTP w/WSE
- Potential for underestimating additional storage needs if LORS-08 schedule is assumed in RWPP Modeling
- Analysis confirmed the necessity of revising the Lake Okeechobee regulation schedule once regional storage is available in order to take advantage/optimize use of storage and maximize benefits to all system components including-
  - Lake Okeechobee Water Levels
  - Estuary Discharges
  - Water Supply

## Bottom Line

- Use of WSE for RWPP modeling ensures consistency with LOTP
- Unlikely that LORS-2008 will exist concurrently with Northern Everglades storage
- Inability to predict future Lake Okeechobee regulation schedule, however design of future schedules will take into consideration additional storage provided by CERP and Northern Everglades
- Need to use the best planning condition for River Watershed Plans

## Therefore

- RWPP should use WSE as modeling assumption to assure storage needed to protect estuaries will not be underestimated
- It is critical that the Lake Okeechobee regulation schedule be modified to account for and maximize system-wide benefits provided by future regional storage
- The System Operating Manual Study, as required by WRDA 2000, is the means by which to make appropriate modifications to the regulation schedule



# **WARNING!!!**

**This presentation contains technically-explicit materials that may not be well-suited for all audiences.**

**Viewer discretion is advised!!!**

# Preliminary Analysis of the Effects of the New Lake Okeechobee Regulation Schedule (LORS2008) on the Performance of the Lake Okeechobee Technical Plan (LOTP)

*Cal Neidrauer, P.E.,  
Chief Engineer  
Operations Control Department  
South Florida Water Management District*

April 30, 2008

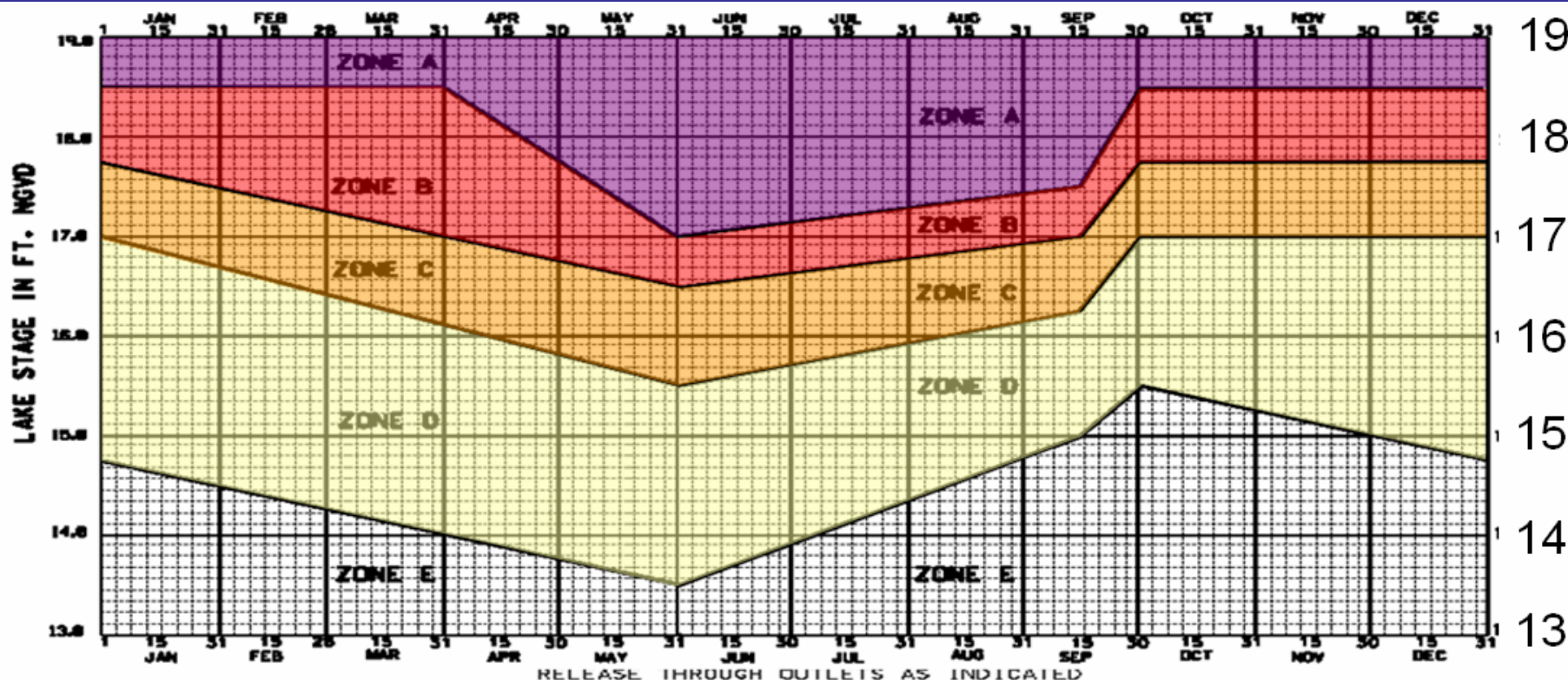
# Topics

- Background on the new Lake O Regulation Schedule (LORS2008) & LOTP
- Question driving this analysis
- Short Answer
- Conclusion & Recommendations
- Longer Answer & Modeling Details

# Background on LORS2008 & LOTP

- LORS2008 has a short planned life (<5 yrs)
- LORS2008 design did not presume new storage
- 2007 LOTP modeling used WSE regulation schedule since LORS2008 was not final
  - USACE Record of Decision April 2008
- New LORS to be designed during the System Operating Manual (SOM) Study which is scheduled to commence this year.
  - The WRDA 2000, through its programmatic regulations, requires the USACE and SFWMD to develop the SOM to ensure that the goals and purposes of the CERP are achieved.
  - The new LORS will be developed considering the combined effects of all system components expected to be operational by ~2012 (Band 1 CERP & Accelerated components, etc)
- Unlikely that major storage features of the LOTP will be implemented & operational within the next 5 years.
- So there is only a very small chance that LORS2008 will exist concurrently with LOTP storage.

# 2000 Lake Okeechobee Regulation Schedule (WSE)



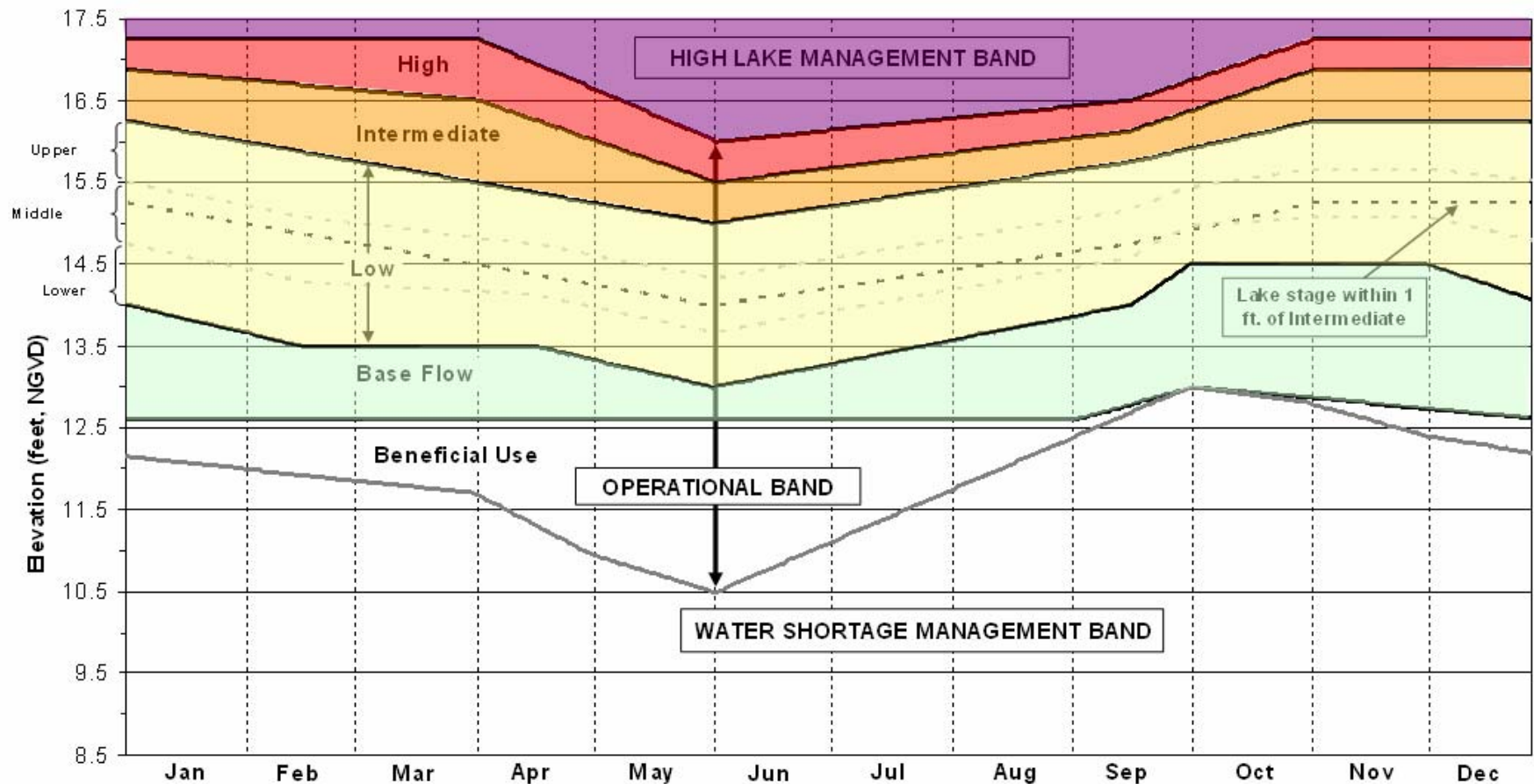
ZONE	AGRICULTURAL CANALS TO NCAs (1,2)	CALOOSAHATCHEE RIVER AT S-77 (1,2,4)	ST. LUCIE CANAL AT S-80 (1,2,4)
A	PUMP MAXIMUM PRACTICABLE	UP TO MAXIMUM CAPACITY	UP TO MAXIMUM CAPACITY
B (3)	MAXIMUM PRACTICABLE RELEASES	RELEASES PER DECISION TREE (THESE CAN RANGE FROM MAXIMUM PULSE RELEASE UP TO MAXIMUM CAPACITY)	RELEASES PER DECISION TREE (THESE CAN RANGE FROM MAXIMUM PULSE RELEASE UP TO MAXIMUM CAPACITY)
C (3)	MAXIMUM PRACTICABLE RELEASES	RELEASES PER DECISION TREE (THESE CAN RANGE FROM NO DISCHARGE UP TO 6500 CFS)	RELEASES PER DECISION TREE (THESE CAN RANGE FROM NO DISCHARGE UP TO 3500 CFS)
D (3,5)	AS NEEDED TO MINIMIZE ADVERSE IMPACTS TO THE LITTORAL ZONE WHILE NOT ADVERSELY IMPACTING THE EVERGLADES. (SEE NOTE 5.)	RELEASES PER DECISION TREE (THESE CAN RANGE FROM NO DISCHARGE UP TO 4500 CFS)	RELEASES PER DECISION TREE (THESE CAN RANGE FROM NO DISCHARGE UP TO 2500 CFS)
E	NO REGULATORY DISCHARGE	NO REGULATORY DISCHARGE	NO REGULATORY DISCHARGE

- NOTES: (1) SUBJECT TO FIRST REMOVAL OF RUNOFF FROM DOWNSTREAM BASINS  
 (2) GUIDELINES FOR WET, DRY AND NORMAL CONDITIONS ARE BASED ON: 1) SELECTED CLIMATIC INDICES AND TROPICAL FORECASTS AND 2) PROJECTED INFLOW CONDITIONS. RELEASES ARE SUBJECT TO THE GUIDELINES IN THE WSE OPERATIONAL DECISION TREE, PARTS 1 AND 2.  
 (3) RELEASES THROUGH VARIOUS OUTLETS MAY BE MODIFIED TO MINIMIZE DAMAGES OR OBTAIN ADDITIONAL BENEFITS. CONSULTATION WITH EVERGLADES AND ESTUARINE BIOLOGISTS IS ENCOURAGED TO MINIMIZE ADVERSE EFFECTS TO DOWNSTREAM ECOSYSTEMS.  
 (4) PULSE RELEASES ARE MADE TO MINIMIZE ADVERSE IMPACTS TO THE ESTUARIES  
 (5) ONLY WHEN THE NCAs ARE BELOW THEIR RESPECTIVE SCHEDULES

CENTRAL AND SOUTHERN FLORIDA  
 INTERIM REGULATION SCHEDULE  
 LAKE OKEECHOBEE  
 DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT  
 CORPS OF ENGINEERS, JACKSONVILLE, FLORIDA  
 DATED: 5 NOVEMBER 1999

WSE (WITH CLIMATE OUTLOOK)

# 2008 Interim Lake Okeechobee Regulation Schedule (2008 LORS)



## NOTES:

**High Lake Management Band:** Outlet canals may be maintained above their optimum water management elevations.

**Operational Band:** Outlet canals should be maintained within their optimum water management elevations.

**Water Shortage Management Band:** Outlet canals may be maintained below optimum water management elevations.

## CENTRAL AND SOUTHERN FLORIDA PROJECT

### 2008 LAKE OKEECHOBEE INTERIM REGULATION SCHEDULE PART B

DATED: March 2008  
DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT  
CORPS OF ENGINEERS, JACKSONVILLE, FLORIDA

# What is Baseflow?

- Baseflow is a regulatory discharge component of the LORS2008
  - Up to 450 cfs at S-79
  - Up to 200 cfs at S-80
- Baseflow was designed to help decrease Lake stages & reduce need for high discharges to the estuaries
- If the baseflow happens to help meet the environmental water supply needs of the estuaries, then that is considered as an incidental benefit of the regulatory discharge.
  - A regulatory discharge is not the same as a water supply release (push vs pull)

# Question driving this analysis

*What are the potential effects of LORS2008 on LOSA water supply and the Caloosahatchee & St. Lucie estuaries assuming the Lake Okeechobee Technical Plan (LOTP) is implemented?*

- All Accelerated (A8) projects are assumed to be operational (EAA A-1 Reservoir, C43 & C44 Reservoirs, etc)*
- LOTP represented by 914 kaf of storage reservoirs*

# Short Answer

- Hypothetical scenario of LORS2008 with LOTP tested using a screening-level hydrologic model (RESOPS)
- Performance of LOTP with LORS2008 (relative to WSE) shows:
  - LOSA water supply performance slightly worse
  - High discharges to the Caloos. Estuary slightly better
  - High discharges to the St.Lucie Estuary slightly worse
    - Decrease in high discharges triggered by Lake O
    - Increase in high discharges triggered by Basin runoff
  - Decreased utility of the C43 & C44 Reservoirs
    - LORS2008 baseflow reduces need for basin reservoirs to meet estuary needs

# Short Answer (continued)

- LORS will need adjustments to be compatible with NETP and CERP reservoirs
  - Analysis shows that removing the baseflow provision of the LORS2008 is one possible adjustment to restore performance back to that of the LOTP with WSE
- LORS modifications to be performed via the System Operating Manual (SOM) Study as required by WRDA 2000
- LOTP and Caloos. & St. Lucie RWPP modeling efforts can safely use LORS2000 (aka WSE)
  - LORS2008 will likely be replaced before LOTP & RWPP implementation
  - Using LORS2008 may lead to over-estimation of estuary low-flow performance.

# Simulation Test Cases

## **Test 0:** Baseline WSE without LOTP storage

- Includes reservoirs in C43 & C44 basins & EAA (A1)
- Lake O. supplements C43 reservoir to supply Caloos. Estuary environmental WS needs
- No Lake O. releases to supplement C44 reservoir to supply St. Lucie Estuary environmental WS needs
- Southern b.c. flows, basin runoff & demands based on SFWMM 2010A8 simulation used for LOTP RSM model development & validation comparison.

## **Test 1:** LOTP (Alt4) storage (914 kaf) with WSE

## **Test 2:** LOTP storage with LORS2008

- LORS2008 Baseflow regardless of estuary needs

## **Test 3:** LOTP storage with LORS2008

- LORS2008 without Baseflow regulatory discharge

# Summary of Performance Relative to LOTP w/WSE

☺ = improves

☹ = insignificant change

☹ = worsens

	Test 2 vs Test 1	Test 3 vs Test 1
Performance Measure	LOTP w/LORS08	LOTP w/LORS08 (no baseflow)
High Lake O Stages	☺	☺
Low Lake O Stages	☹	☹
LOSA Water Supply	☹	☹
Northern Reservoir Utility	☺	☺
C43 & C44 Reservoir Utility	☹	☹
Caloos. Est. high flow mos (from runoff / from LOK)	☺ ☹ / ☺	☺ ☹ / ☺
Caloos. Est. low flow mos	☹	☹
St. Lucie Est. high flow mos (from runoff / from LOK)	☹ ☹ / ☺	☹ ☹ / ☹
St. Lucie Est. low flow mos	☺	☺

# Conclusions & Recommendations

- Revisions to the Lake O Regulation Schedule (LORS) will be needed when CERP &/or LOTP storage facilities are operational
- System-wide evaluation is needed to consider the combined effects of new project features and design a LORS that provides the best balance among the multiple objectives
- System Operating Manual (SOM) Study will design a new LORS to be compatible with new storage areas to be implemented by CERP (Band 1) & Accelerated projects circa 2012.
- St.Lucie & Caloosahatchee RWPP analysis can continue to use the WSE regulation schedule since:
  1. LORS2008 is likely to be replaced prior to implementation of LOTP & RWPP storage projects.
  2. Use of LORS2008 may lead to over-estimation of estuary performance & possible under-estimation of RWPP storage.

# Longer Answer & Modeling Details

- Methodology – modeling approach
- Summary of Test Case Assumptions
- Summary of Simulated Performance
- Performance Measure Outputs

# Methodology – modeling approach

- Analysis performed using the REservoir Sizing and OPerations Screening (RESOPS) spreadsheet model version 1.9 (Neidrauer 2007-08).
  - Continuous simulation model of the south Florida water management system including Lake Okeechobee, the C43 & C44 Basins, Caloosahatchee & St. Lucie Estuaries.
  - Screening-level model
    - Monthly time-step
    - Relies on basin runoff, demands, and southern boundary condition flows from other models (SFWMM or RSM)
    - Can test system response to changes in storage area sizes & operations
- RESOPS can:
  - simulate the key features of the new Lake Okeechobee Regulation Schedule (LORS), named LORS2008.
  - represent changes in flows to the estuaries expected from the implementation of both LORS2008 and the storage features proposed by the LOTP and by CERP for the C43 & C44 basins.
- Southern Boundary Condition Assumption
  - the EAA A-1 Reservoir is assumed to exist and flows from Lake O are assumed the same as those used for the LOTP simulations.

# Summary of Test Case Assumptions

	Test 0	Test 1	Test 2	Test 3
	2010A8 w/WSE	LOTP w/WSE	LOTP w/LORS08	LOTP w/LORS08 (no baseflow)
North Reservoir Volume	n/a	914 kaf	914 kaf	914 kaf
EAA Reservoir Volume	190 kaf	190 kaf	190 kaf	190 kaf
Lake to EAA Reservoir (b.c.)	342 kaf/yr	342 kaf/yr	342 kaf/yr	342 kaf/yr
C43 Reservoir Volume	160 kaf	160 kaf	160 kaf	160 kaf
C44 Reservoir Volume	45 kaf	45 kaf	45 kaf	45 kaf
Lake O Regulation Schedule	WSE	WSE	LORS2008	LORS2008
- Baseflow Reg to estuaries?	n/a	n/a	Yes	No
LOK supplements C43 & C44 reservoirs to meet estuary ws needs?	CE only	CE only	CE only	CE only

# Summary of Simulated Performance

	Test 0	Test 1	Test 2	Test 3
	2010A8 w/WSE	LOTP w/WSE	LOTP w/LORS08	LOTP w/LORS08 (no baseflow)
High LOK Stages (%>17')	4.1%	3.7%	1.2%	1.4%
Low LOK Stages (%<10')	1.4%	0.2%	1.2%	0.2%
LOSA WS Cutbacks (41-yr)	7.9%	5.9%	7.6%	6.8%
LOSA WS Cutbacks (7dr-yr)	17.5%	8.9%	15.8%	12.6%
N. Reservoir Div/Rel (kaf/yr)	N/A	235/191	268/244	257/224
C43 Res. Div/Rel (kaf/yr)	137/128	140/133	90/75	140/132
C44 Res. Div/Rel (kaf/yr)	35/29	37/31	27/17	37/31
Caloos. Est. high flow mos	67	58	55	53
High flow mos from runoff	28	28	34	28
Additional highs from LOK	39	30	21	25
Caloos. Est. low flow mos	18	11	10	13
St. Lucie Est. high flow mos	86	78	82	79
High flow mos from runoff	55	53	60	55
Additional highs from LOK	31	25	22	24
St. Lucie Est. low flow mos	59	61	20	57

# Summary of Results

- Assuming the unlikely concurrent existence of LOTP storage & LORS2008, a simulation analysis was conducted to identify the potential effects on the performance of the system.
- Analysis shows that without modifications to LORS2008 to account for new storage areas, then several of the system performance measures are affected.
- Specific performance changes include the following:
  1. Lower lake stages result from LORS2008. The low stages are improved with releases from the Northern Reservoirs, but those releases do not compensate during all droughts. Therefore there is a reduction in water supply performance.
  2. The baseflow regulatory discharge feature of LORS2008 reduces the need for the C43 & C44 basin reservoirs to make environmental water supply releases to their respective estuaries. This reduced outflow from the basin reservoirs decreases their ability to receive basin runoff during wet periods, and increases the frequency of damaging high discharges to the estuaries from basin runoff.
  3. The increase in damaging discharges to the estuaries from basin runoff is less than the decrease in damaging discharges from the Lake; so the Estuary flow distributions are similar or slightly improved.

# Summary of Results (continued)

- Further testing shows that with a minor modification to LORS2008 to account for new storage areas, then the system performance would be similar to that of LOTP with the WSE Lake O Regulation Schedule
- Specifically, the modification was to turn-off the baseflow regulatory discharge feature of LORS2008 to allow the C43 and C44 basin reservoirs to better achieve their intended purposes
- With the baseflow regulatory discharge feature of LORS2008 turned-off, simulation results show:
  1. High Lake stages comparable to LOTP w/LORS2008 & lower than NETP w/WSE
  2. Low Lake stages comparable to LOTP w/WSE
  3. Water supply performance better than NETP w/LORS08, but still slightly worse than LOTP w/WSE
  4. C43 & C44 reservoir utility similar to LOTP w/WSE
  5. St. Lucie Estuary high discharge performance similar to LOTP w/WSE
  6. Caloos. Estuary high discharge performance better than LOTP w/WSE